Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (original) A method for measuring information loss, or conditional entropy, of a paper channel, said paper channel comprising:

(a) a symbol input defining symbols to be printed;

(b) a bitmap generator responsive to said symbol input to generate bitmaps representative of corresponding input symbols;

(c) a printer responsive to said bitmap generator to print on a substrate symbol images substantially determined by said bitmaps; and

(d) an imager to capture said images from said substrate and generate corresponding image signals, said method comprising the steps of:

i) selecting a general, parametric, statistical model for said paper channel;

ii) selecting a plurality of test bitmaps;

iii) transmitting said test bitmaps through said paper channel to obtain a set of test image signals for each of said symbols, each of said sets containing at least one test image signal;

iv) adjusting parameters of said model so that image signals predicted by said model for said set of test bitmaps substantially conform to said sets of test image signals, whereby a particular parameterization of said model substantially accurately describing said paper channel is obtained; and

v) determining an estimate for the information loss of said channel in accordance with said particular parameterization.

2. (original) A method as described in claim 1 wherein said model is defined in terms of a random variable S representative of a scanned image on a lattice corresponding to a print field and a second random variable B corresponding to bitmaps input to said paper channel; and wherein said random variable S takes on values s^j_i at points j in said lattice, where i labels an image selected from a set of possible images, and wherein said random variable B takes on values b^j_c at points j in said lattice, where c labels a symbol selected from a set of said symbols to be printed.

3. (original) A method as described in claim 2 wherein said model is analogous to an Ising model for the distribution of spin on a two-dimensional lattice in the presence of a field.

4. (original) A method as described in claim 3 wherein said model has the form:

$p(s \mid b_c) = \exp(-E(s \mid b_c)/ \exp(\Sigma_{s'}(-E(s' \mid b_c))$; where $p(s \mid b_c)$ is the conditional probability that said random variable S will take on the particular value s assuming that said random variable B takes on the particular value b_c corresponding to the input of symbol c, and $\Sigma_{s'}$ represents summation over all values of s; and where:

$E(s \mid b_c) = -\sum_j (b_c^j \cdot s^j + J \cdot \sum_{nn} s^j \cdot s^{j'})$; where J is a coupling factor and $\sum_{nn}$ represents summation over nearest neighbors $s^{j'}$ in said lattice.

5. (original) A method as described in claim 1 wherein said values b^j_c and s^j_i are binary values, and said image is a monotone image.

6. (original) A method as described in claim 1 wherein said values b^j_c and s^j_i are integer values, and said image is a discrete gray-scale image.

7.(original) A method as described in claim 1 wherein said values b^j_c and s^j_i are continuous values, and said image is a gray-scale image.

8. (original) A method as described in claim 1 wherein said values b^j_c and s^j_i are vector values, and said image is a color gray-scale image.

9. (original) A method as described in claim 1 wherein said model can be calculated analytically.

10 (original) A method as described in claim 1 wherein said test bitmaps correspond to a selected subset of said symbols to be printed.

11. (original) A method as described in claim 1 wherein said test bitmaps comprise at least one test pattern designed to show local distortions of said paper channel.

12. (original) A method as described in claim 1 wherein said parameters vary as functions of position in a print field or page.

13. (original) A method as described in claim 1 wherein step e) comprises the further steps of:

a) selecting one of said symbols to be printed from at least a subset of said symbols to be printed, and, for a predetermined number of iterations;

a1) computing a random value for an image signal in accordance with a conditional probability distribution for said image signals assuming said selected symbol, said conditional probability distribution being determined by said particular parameterization;

a2) for said selected symbol determining, in accordance with said particular parameterization, a conditional probability of said selected symbol, assuming said computed random output image signal;

b) over said predetermined number of iterations, determining the mean conditional entropy, or information loss in transmitting said selected symbol over said paper channel, as a function of said conditional probabilities determined in sub-step f2)

c) repeating steps a and b for all remaining ones of said subset of symbols to be printed; and

d) averaging said conditional entropies determined in step g over all of said test symbols to determine an approximate measure of the channel entropy, or information loss in bits per printed symbol.

14. (original) A method for selecting or modifying a design for, or composition of, a component of a paper channel, said paper channel component being; a bitmap generator responsive to said symbol input to generate bitmaps selected from a stored set of bitmaps and representative of corresponding input symbols, a printer responsive to said bitmap generator to print on a substrate symbol images substantially determined by said bitmaps, an imager to capture said images from said substrate and generate corresponding image signals, said substrate, an ink use by said printer, or said set of bitmaps, said method comprising the steps of:

a) determining an average information loss per symbol when a first design or composition is used for said component;

b) comparing said average information loss per symbol for said first design or composition with a previously determined average information loss per symbol when a previous design or composition is used for said component; and

c) selecting whichever of said designs or compositions has the lower average information loss per symbol.

15. (original) A method as described in claim 14 comprising the further steps of:

d) substituting said selected design or composition for said previous design or composition;

e) substituting a next design or composition for said first design or

f) repeating steps a through e until predetermined conditions are satisfied.

16. (original) A method as described in claim 15 wherein said next design or composition is selected from a predetermined group of designs or compositions.

17. (original) A method as described in claim 15 wherein said next design or composition is obtained by modifying said design or composition selected in step c.

18. (original) A method as described in claim 14 wherein said average information loss is determined by the further steps of:

a) selecting a general, parametric, statistical model for said paper channel;

b) selecting a plurality of test bitmaps representative of at least a subset of said symbols to be printed;

c) transmitting said test bitmaps through said paper channel to obtain a set of test image signals for each of said symbols, each of said sets containing at least one test image signal;

d) adjusting parameters of said model so that image signals predicted by said model for said set of test bitmaps substantially conform to said sets of test image

signals, whereby a particular parameterization of said model substantially accurately describing said paper channel is obtained;

e) determining an estimate for said average information loss in accordance with said particular parameterization.

19. (original) A method as described in claim 18 wherein said model is defined in terms of a random variable *S* representative of a scanned image on a lattice corresponding to a print field and a second random variable *B* corresponding to a bitmap input to said paper channel; and wherein said random variable *S* takes on values s_i^j at points *j* in said lattice, where *i* labels an image selected from a set of possible images, and wherein said random variable *B* takes on values b_c^j at points *j* in said lattice, where *c* labels a symbol selected from a set of said symbols to be printed.

20. Cancel

21. Cancel

22. A method for measuring information loss, or conditional entropy, of a paper channel, said paper channel comprising; a symbol input defining symbols to be printed, a bitmap generator responsive to said symbol input to generate bitmaps representative of corresponding input symbols, a printer responsive to said bitmap generator to print on a substrate symbol images substantially determined

by said bitmaps, and a imager to capture said images from said substrate and generate corresponding image signals, said method comprising the steps of:

a) selecting a general, parametric, statistical model for said paper channel;

b) selecting a plurality of test bitmaps;

c) transmitting said test bitmaps through said paper channel to obtain a set of test image signals for each of said symbols, each of said sets containing at least one test image signal;

d) adjusting parameters of said model so that image signals predicted by said model for said set of test bitmaps substantially conform to said sets of test image signals, whereby a particular parameterization of said model substantially accurately describing said paper channel is obtained; and

e) analytically determining said information loss in accordance with said particular parameterization.